THE ELECTRONIC VOTE

Washington
Secretary of State
SAM REED

Across America, elections are undergoing sweeping changes. One of the most significant is the introduction of Direct Recording Electronic Voting Systems or DREs. DREs are often referred to as touch screen voting machines. They display an electronic ballot and prompt the voter through every race and measure, much like an ATM guides you through the process to deposit or withdraw money.

Federal law requires every state in the nation to set up one DRE per poll site by 2006 because of the benefits these voting systems provide to those with disabilities. The Washington Secretary of State's Office has reviewed these systems and offers this paper as commentary on the topic.

Proven accuracy of touch screen voting

Research shows touch screen voting machines are more accurate in recording voters' choices than any existing voting system. This is because they eliminate any need for manual interpretation of voter intent. The California Institute of Technology and the Massachusetts Institute of Technology created a statistic to help measure voter accuracy. This statistic, called the "residual voting rate," measures the number of ballot mistakes that can be attributed to the voting system. Their research shows modern DREs result in a more accurate ballot because they give voters an opportunity to review their ballots and correct mistakes.

This opportunity is called second-chance voting. The voting system alerts voters if they select more than one candidate in a given race. Because voters are able to review their selections before casting their ballots, they are also alerted to any contests or issues they may have inadvertently skipped.

Help for voters with disabilities

DREs benefit those with disabilities allowing voters, in some cases, to cast ballots independently for the first time. Those with impaired vision, for example, can independently listen to audio ballots using headphones instead of relying on a family member or election board worker to record their votes. This audio feature is also used to review voters' selections before their ballots are cast.

In addition, DREs can display the ballot in a number of languages and offer large print. The machines may also be fitted with devices designed to assist people with limited motor skills.

For example, equipment can be retrofitted with a straw-like device allowing paraplegic voters to make their selections by "sipping and puffing" on the straw. Most DRE voting devices are designed with adjustable height and screen angles to meet a variety of special needs.

History of voting technology

Voting machines, originally called lever machines, were first introduced a century ago. These entirely mechanical machines feature a complex series of gears and wheels to record voters' choices. At the end of the voting period, odometer-like wheels that show the total vote for each candidate are read and recorded by hand. Although Washington outlawed the machines in the early 1990s for failing to provide an audit trail, this old system is still used in many jurisdictions in America.

Lever machines have limited reliability and depend on human beings to read, record, and tabulate results. Because they are purely mechanical, they offer no

" We were so impressed with the technology that we converted our entire polling place voting environment to DRE voting in 2002. "

Bob Terwilliger
Snohomish County Auditor

COUNTIES PARTICIPATING IN DRE PILOT PROJECT

THURSTON COUNTY	COWLITZ COUNTY	PIERCE COUNTY	SNOHOMISH COUNTY

instructions to the user to properly operate the system.

The first effort to modernize the lever machine yielded the full-face DRE system. These are simply automated lever machines. These systems employ rudimentary computers to tally votes. Votes are recorded by pushing buttons that cause lights to illuminate, indicating voters' choices. These systems maintain the advantages of a voting machine (ease of use, no over-voting) while employing modern electronic recording and tallying methods. Unfortunately, full-face DRE systems rely on mechanical buttons and lights and use hard-to-read labels to mark the voting positions. They do not provide access for voters with disabilities or alternative languages.

Lever machines are limited to recording cumulative vote totals for each contest or ballot issue. A complete record of each individual ballot cast is not maintained or recorded.

Modern DREs

Modern DRE voting systems are touch screen systems. They are entirely computer-based and present the ballot one contest and issue at a time. They offer the advantage of entirely computerized vote recording and reporting. These systems are smaller and very portable. Some weigh as little as 18 pounds. The systems offer all of the advantages of older DRE systems and the additional features of context-sensitive help, multiple language presentation, and a variety of disability access features. The most important of the expanded functions is the ability to work with disabled voters. With visually-impaired voters, the systems communicate privately with each voter through the use of headphones and an audio version of the ballot. The machines can also be fitted with devices designed for people with limited motor skills.

Modern DRE systems record and maintain a record of each individual ballot cast on each machine. Ballot images may be printed for recount purposes if necessary. Additional benefits include the ballot review features and the elimination of manual interpretation of voter intent.

Washington State first certified a DRE system in 1989, with the Sequoia Pacific AVC advantage system. This was a full-face system that was marketed as a lever machine replacement. During the intervening years the subject of disabled ballot access, especially privacy for visually impaired voters, became more and more important. The Secretary of State convened a committee of election experts, disabled community advocates

" Voters overwhelmingly endorse this new technology. It's secure, easy to use, and familiar. "

Dean Logan
Director of Elections

and voters to study the issue. The group very quickly realized that assistive technology offered the best solution. Until DRE technology came along, visually-impaired citizens unable to physically read their ballots were forced to rely on another person to vote. With the modern DRE, the machine reads the ballot and helps the voter record his or her own ballot using familiar tools. Those with certain disabilities may therefore vote a truly secret ballot for the first time. Several machines have been demonstrated at conferences and advocacy meetings with excellent acceptance.

DRE field tests

In late 2001, the Secretary of State reviewed four DRE voting systems as a preliminary step toward certification. Citizens had the opportunity to use touch screen machines to cast binding votes. One voter commented, "Even the computer-illiterate can do this." Many pointed out that while they prefer to vote through the mail, this is an improvement at the poll site.

The Secretary of State published a report on the success of the touch screen pilot project. The certification documents and the DRE test reports are available at www.secstate.wa.gov
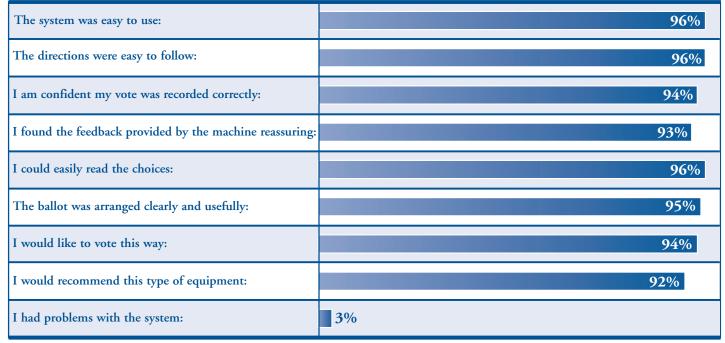
Help America Vote Act

In 2002, the Federal Government, through the passage of the Help America Vote Act (HAVA), mandated every poll site in the United States offer at least one disability access voting system by January 1, 2006. The Act specifically calls for the use of DRE technology to meet the requirement. Washington has prepared a HAVA implementation plan that details the manner in which DRE technology will be used to meet this new federal requirement.

DRE system operation

Generally, all modern DRE systems operate in the same fashion. Each voter is issued a token or ballot code that identifies his or her assigned ballot type. He or she approaches the voting machine, inserts the token, or enters the ballot code to initiate the voting process. The correct ballot type is presented to the

VOTERS FAVOR TOUCH-SCREEN VOTING

The system was easy to use:	96%
The directions were easy to follow:	96%
I am confident my vote was recorded correctly:	94%
I found the feedback provided by the machine reassuring:	93%
I could easily read the choices:	96%
The ballot was arranged clearly and usefully:	95%
I would like to vote this way:	94%
I would recommend this type of equipment:	92%
I had problems with the system:	3%

Survey results are from 814 people who participated in the DRE voting system field tests.

voter and the machine prompts him or her through each contest and ballot measure.

DRE systems have the ability to skip races at the voter's request. The voter can record write-in votes letter by letter. Once the voter has finished recording his or her selections, a summary of the vote is presented for final review and confirmation. Once confirmed by the voter, the ballot is cast.

Maintaining the integrity of voting systems

Before any system may be sold or used in Washington State it must first be examined by the Secretary of State.

Voting systems and software have been on the market since the 1960's. Concerns about quality and integrity led to the regulation of electronic and computerized systems. Most states require state-level certification before ballot-counting systems may be purchased. The thoroughness of certification varies widely. Beginning in 1990, the National

Association of State Election Directors (NASED) and the Federal Elections Commission (FEC), Office of Election Administration cooperated on the creation of federal Voting Systems Standards (VSS). The VSS contain very specific standards for nearly every aspect of the hardware and software used in ballot counting.

NASED has contracts with three Independent Testing Authority (ITA) laboratories to evaluate voting systems against the VSS. In practice, a system vendor wishing to sell a voting system in the United States must first have the system evaluated and passed by an approved ITA before attempting state certification. Additionally, all voting systems must first be certified and in use in at least one other state. As a result, each system has been evaluated nationally and reviewed by the Secretary of State before it is certified.

The national ITA laboratories allow a great deal of expertise to be applied to a relatively obscure area of interest. Most states could not possibly afford

to keep hardware and software experts on staff. No state could justify an investment in testing facilities. The ITA system pools resources. Instead of holding simple tests in 50 states, more thorough tests are held nationally.

Currently, there are three approved ITA laboratories in the United States. WYLE Laboratory in Huntsville, Alabama, handles all hardware and firmware testing. This includes checking the operation of the systems in many different environments (high and low heat, humidity, dust, shock, shaking and Radio Interference) and for minimum operating reliability. This is done to make sure the system is accurate and will maintain its function and accuracy over time in real world conditions (cold storage areas, the tropics, the desert, transported in trucks, dropped in delivery, etc.)

There are two ITA laboratories that review, test, and escrow the voting system software and source code. One is Ciber Labs in Huntsville, Alabama. The other is Systest Labs in Denver, Colorado. Their job is to escrow and review all of the computer

" Besides quicker results and ensuring voter intent, we recognize that the most important attribute these machines have is allowing those voters with disabilities to truly cast their ballot independently – possibly for the first time. "

Kristina Swanson
Cowlitz County Auditor

code, line by line, and confirm it works correctly and is properly documented. Once the software review is complete the ITA performs a complete "system build" and counts ballots with the system to confirm its accurate function.

Concerns about audit trails have been raised relative to DRE systems. Other voting systems in Washington State feature paper ballots which serve as the final "audit trail". DRE systems also have very complete audit trails, but they are electronic until such time that they are converted to paper during the counting process and printed for a hand recount. The Voting Systems Standards (VSS) are very lengthy and complete. The VSS were written by security experts, computer experts and election experts, with an eye toward secure elections. The standards contain information on system management and security that relate to the entire voting system, including software coding, election programming, testing, ballot counting, and reporting. Modern systems create logs that track every action taken on the system and they feature multiple levels of redundancy in storage.

Across the country, interest groups have taken up the issue of an audit trail.

The State of California commissioned a task force of technology experts and election professionals and published an in-depth report. It concluded that some form of voter verified audit trail should be required for voting systems acquired after the HAVA implementation. However, the report did not conclude that a paper trail was required.

The League of Women Voters (LWV) has also produced a report highlighting the value of privacy to those with disabilities. People with certain disabilities who cast a ballot using a DRE can vote a truly secret ballot for the first time. In its report, the LWV stated, "The LWVUS does support an individual audit capacity for the purposes of recounts and authentication of elections for all voting systems, including, but not limited to, DREs. The LWVUS does not believe that an individual paper confirmation for each ballot is required to achieve those goals; in fact this is unnecessary and can be counterproductive. An individual paper confirmation for each ballot would undermine disability access requirements, raise costs, and slow down the purchase or lease of machines that might be needed to replace machines that don't work. Simply because a voter verifies their vote on the piece of paper does not guarantee the same

results have been recorded within the machine and vice versa.

Increasing machine reliability

DREs are far superior in detecting equipment failure and programming errors than any other voting system. Because modern DREs provide immediate feedback and a confirmation screen at the end, equipment problems become immediately evident to the voter and a malfunctioning machine can be taken out of use immediately.

In addition to the other redundant memory, each DRE machine has the equivalent of a hard disk and a floppy disk. The floppy disk is removed and read to tabulate votes. The hard disk remains in the machine and is an independent back-up. The machine also generates tape that represents the cumulative votes cast for all issues and candidates on that machine. This is one more back-up to the information on the disk or the memory packs. Finally, a paper representation of each ballot cast can be generated for the purposes of a hand recount. This would demonstrate if there was a breakdown in the programming that accumulates the results and combines them with the absentee ballot totals.

Testing and security

Special testing occurs before every election to ensure the system is secure and working properly. State law requires the Secretary of State to conduct public logic and accuracy tests to verify the programming is recording votes accurately. After the tests are finished, the equipment and programming are sealed until Election Day. Security must be viewed as a function of several elements. These elements include system design, physical access control, electronic access control, and testing.

Dr. Brit Williams, a computer science professor and elections expert for the State of Georgia, points out that the use of appropriate election policies and procedures on system access and control make tampering nearly impossible. There are a number of obstacles.

Practically speaking, anyone attempting to tamper with a DRE voting system would need to:

- Acquire knowledge of the software programming language.

- Locate every place the software checks itself to verify numbers it's reporting are accurate.

- Understand the language and version of the software used to compile the program.

- Obtain an identical version of the compiler in order to reverse engineer the software.

- Gain access to the software storage location for sufficient time to actually replace the software.

- Manipulate the software to ignore the pre-election test(s) and only initiate itself on Election Day.

- Alter the software to actually change votes throughout the day, and do so undetected.

- Alter the software to erase itself before any post-election test.

- Gain physical access to the voting units to change internal chips, if the software is programmed onto a ROM, a Read Only Memory chip.

- Gain access a second time to remove malignant ROMs after the election and replace them with the real ones.

- Follow this entire process for each type of DRE, in states that use multiple vendors.

- Gather a significant number of people with substantial, unsupervised access to execute the process, undetected.

Conclusion

The disabled access modules, and the system ability to display the ballot in many languages, give these DRE devices unique capabilities for serving all voters. These systems provide an exciting new tool for county election administrators to assist their voters. In the future, county election administrators will be aided by the ability of these systems to store and display every ballot. Touch screens could ultimately allow the state to set up fewer polling places and to offer citizens early voting options.

As required by the HAVA, each county must evaluate its existing voting system and select from the options available to bring touch screen machines online by 2006. Counties must either adopt DRE voting machines for all poll-site voting or integrate the addition of a DRE machine at each poll site that is compatible with its current voting system.

Touch screen voting machines serve several functions in the 21st Century. They allow those with certain disabilities to vote a truly secret ballot for the first time. They give Washington an opportunity to put modern technology to work in a way that benefits the state and every voter.

" The integrity of elections in Washington is my highest priority. Electronic voting improves security, reduces the number of voter mistakes, and helps ensure every citizen the right to a secret ballot. "

Sam Reed
Secretary of State

Washington
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SAM REED

Elections Division
Dean Logan, Director of Elections
PO Box 40229
Olympia, WA 98504-0229
Telephone: 360.902.4180
Toll-Free: 800.448.4881
TDD/TTY: 800.422.8683
Email: elections@secstate.wa.gov
Website: www.secstate.wa.gov/elections

This report was written by David M. Elliott, Assistant Director of Elections.